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ARCHIVAL PRESERVATION IN THE AGE OF TECHNOLOGY

Lisa L. Fox

If there was ever a time when archives and libraries were places of refuge from the flux of the surrounding world, that era has entirely disappeared with the advent of the information age. The jargon of the high-tech world (Machine-Readable Cataloging [MARC], standards, communication protocols, and bits and bytes) has flooded the professional literature as archivists consider automating their processing, reference, and administrative functions. New technologies are being made available which require the archivist to make increasingly complex decisions regarding a vast array of options.

It might have seemed that preservation would be exempt from the high-tech revolution, for it has been especially the arena of those motivated largely by their bibliophilic interest in the books, manuscripts, photographs, and other documents that record a collective heritage. But the effects of technology extend even to preservation. Emerging technologies--especially those associated with automation--present many new strategies for arresting deterioration, but some of these technologies also complicate the task of preservation. This paper will examine some obstacles and opportunities that technology will present to the archival profession, and will suggest ways to begin planning for these changes.

Computer Technology: New Issues in Preservation

Archival collections reflect cultural change. Repositories that initially held handwritten manuscripts eventually began to receive typewritten and printed documents. Photographic collections reflect the changes from daguerreotypes through today's color processes. Materials in special collections reveal the development of sound recording technologies from cylinders and wire recordings through vinyl disks and plastic tapes. It is reasonable to assume that archival repositories will also be affected by the current proliferation of microcomputers.

In the home, microcomputers are being used to maintain financial and medical records, automobile maintenance history, copies of outgoing correspondence, family history, even recipes. In government, business, and academic offices, microcomputers are being used for all sorts of accounting, word processing, and planning purposes. It is likely that microcomputers will be increasingly used for maintaining "electronic notebooks," for submitting and publishing articles, and for sending, receiving, and storing professional correspondence and other documents.

Some of the government employees, scholars, private citizens, and business people who are now using microcomputers and electronic communications to good effect in the home and office will become the donors to archives and manuscript collections in the coming years. Future donations may consist not only of traditional media such as correspondence, manuscripts, photographs, clippings, books, and recordings, but also printouts on computer paper and even of the "floppy disks" that are used to store microcomputer programs and files. These will, of course, have their impact on archival processing; the arrangement and description of floppy disks, for example, may require new procedures. But how will the microcomputer affect preservation? Archivists and manuscript curators must address at least two elements of microcomputer technology--disks and paper--in their preservation planning, as both are impermanent media.

With the increased use of computer storage, many archives and libraries are beginning to receive an increasing volume of magnetic media, such as the floppy disks and computer tapes on which electronic data are stored; they must, therefore, consider the preservation of these materials. Although the importance of computer data on magnetic tape and disk has spurred considerable research into the causes of deterioration and into strategies for preserving these media, scientific testing is still incomplete and inconclusive and definite standards have not yet been established. Computer tapes and floppy disks require special storage conditions and handling procedures and they should not be relied upon as permanent media; even when stored in optimum conditions, tape has an expected shelf life of only ten to twenty years.[1] Floppy disks appear to be somewhat more durable than tape, perhaps because they are not subjected to the same mechanical action in use. There are some general guidelines for the storage and handling of these media: (1) store master copies at a temperature not above 70 degrees Fahrenheit and at a relative humidity of 30% (plus or minus 2%); (2) shelve upright on grounded metal shelves to avoid demagnetizing the tape or disk and turn tapes occasionally to avoid uneven gravitational pull; (3) store in meticulously clean canisters or sleeves and do not permit smoking where magnetic media are stored; (4)"read" tapes and disks at least annually to ensure that there has been no degradation of data; and (5) have repairs or transfer of data performed only by a trained technician.[2] Only by exercising proper care of tapes and disks can archivists ensure that this information will be preserved for future users.

Preservation planning should anticipate that there will be changes in technology. While printed documents can be read without the devices that created them, others (such as sound recordings and computer tapes) are useless without accompanying hardware. One university accepted an important collection of wire recordings that was frequently used by researchers; but when the player wore out and could not be replaced, the information on the recordings was lost. Having learned from such experiences, archivists should plan carefully to ensure continued access to computer data in the future.

Computer technology changes rapidly, rendering hardware obsolete within a decade, so archivists should anticipate the future obsolescence of some computer resources. It may now seem quite adequate to accept, process, and store safely a floppy disk created on, say, an IBM Personal Computer. But twenty years from now (or probably much sooner) IBM (assuming it still exists) may no longer make a PC nor the software to support it. How will the information on the well-preserved disks be accessed then? Just as the wire recordings could have been transferred to another medium before the player wore out, so can computer data be preserved in another media for security purposes. Of course, much computer data is of only short-term value, so its long-range preservation is not necessary. However, it might be worthwhile to establish one of two policies to ensure that machine-readable data remain usable in the long range. An archive might implement a policy requiring that machine-readable data which has archival value must, when transferred to the repository, be accompanied by a hard-copy version on permanent paper. Alternatively, schedules for the review and potential re-copying of machine-readable data should be established and consulted regularly.

With the increased use of computers and microcomputers, archivists should expect to begin receiving a great deal of computer printout paper, not only from accounting departments and university registrars, but from the growing number of individuals who use computer technology to compose and communicate for business and personal purposes. As it becomes more widely used, this paper will pose some problems to preservation because of its size and acidity. Although some computer paper is a near standard size, much of the larger eleven-by-fifteen-inch paper is used for large-volume printing. Archival standards dictate that paper documents be stored flat, but the oversized eleven-by-fiften-inch computer paper is slightly too large for regular archival storage boxes. Computer printout paper will also present a challenge because of its high acidic level. At Yale University, an informal sampling of tractor-feed computer paper showed that it had a pH level of around 5.4-- over ten times more acidic than a neutral 7.0 level.[3] Decisions must be made regarding the handling and storage of computer paper, as well as of other materials on highly acidic paper. For example, if stored with less acidic materials, acid from the computer paper will migrate and acidify other items. Highly acidic materials may be filed in a separate box, or at least a separate folder, from more stable papers. Alternatively, the archivist or curator may deacidify such documents or reproduce them on a more permanent medium (such as copies made by a dry-process photocopier on acid-neutral paper). Of course, either of these strategies will entail time and expense. There is cause to hope that the commercial sector will respond to the problems associated with the acidity and size of computer paper. One supplier, for example, has begun offering archival quality computer paper. At present, the curator must use his or her best judgment in assessing the permanent value of the information on acidic paper and then weigh the relative cost and benefit of the available alternatives for dealing with computer paper.

None of these comments is intended to imply that archives and manuscript repositories will suddenly be inundated by floppy disks, computer tape, and printout paper. However, as computer technology comes to play a more important role in education, government, research, and personal life, archivists should expect to notice the impact in the kinds of materials they receive. It is important, therefore, to begin now to plan the preservation response to these technologies.

Just as emerging technologies may pose new preservation challenges, so may they offer new solutions. Two technological solutions should especially be noted in this context. The advent of optical disk technology and the development of mass deacidification processes may provide large-scale and affordable preservation treatment options for archives and libraries.

Optical Disk Technology

The emergence of optical disk technology for computerized mass storage, preservation, and retrieval of printed and graphic materials offers a revolutionary approach to library and archival preservation. The Optical Disk Pilot Program now underway at the Library of Congress (LC) will provide a new way of reformatting materials that do not have to be maintained in their original form and of providing service copies to reduce the handling of originals. In the digital optical disk program, designed for printed materials, pages of text are scanned by laser, converted to electronic signals that can be read by a computer, and stored on optical disks. An optical disk physically resembles a stereo phonograph record; the twelve-inch disk used at LC is designed to contain ten to fifteen thousand pages of text. About one hundred disks will be stored in an Optical Disk Storage Module, or "jukebox," linked to a computer that guides the retrieval of information from the disk and generates terminal screen displays or printed copies for patron use. Because the optical disk project uses laser beams to record printed material in digital form and to retrieve data from the disk without touching the disk surface, wear and tear on the disk is negligible. As part of the pilot program, LC's Preservation Office is testing the durability of an optical disk, for the life expectancy of the physical disk is undetermined.

The primary drawback for most institutions is the cost associated with optical disk applications. Although duplication of a disk is fairly economical, the cost of initially producing an optical disk seems to be very high and the capital expense of an optical disk player, computer, terminals, and printers will be significant. In addition, many questions regarding copyright laws have arisen with the development of optical disk technology. Publishers are concerned about the impact of optical disk, since reproductions of an item on disk may be less expensive than purchase of the hard copy of the publication. Recognizing this potential problem, the Library of Congress is working with the Association of American Publishers, and publishers are represented on LC's Optical Disk Advisory Committee.

The optical disk program provides many benefits as a way of preserving the informational content of documentary resources. The process used to create an optical disk can enhance the original image, that is, a faded or discolored manuscript may be reproduced as a clearer image on the disk. The procedure also has effective quality control mechanisms to ensure that the information can be preserved indefinitely. The creation of an optical disk is virtually error free, and the quality is subsequently checked by computer to provide early detection of degradation. The optical disk is likely to have higher user acceptance than current technologies such as microform, since the terminal display is of higher quality (and the use of a terminal of more personal comfort) than is the case with a microfilm or fiche reader. In addition, the optical disk system generates printouts of excellent quality. Information on an optical disk is readily transferable either to another disk or to some new computer-related medium that may be developed. The optical disk also offers many benefits in retrieval. Because the patron and computer have random access to the disk, it is simple to locate and retrieve precisely the desired material (provided that sufficient indexing has been performed), and users could have access by telecommunications to a disk at a remote computer installation. Finally, materials on microfilm can be scanned and transferred to optical disk, so the institutions that have taken advantage of microfilming as a preservation strategy will be in a good position to take advantage of the benefits of optical disk.

If successful, the Optical Disk Pilot Program may provide a technology than can enable archives and manuscript collections to preserve and provide ready access to endangered materials in a way that is economical on a large scale and adaptable to subsequent technologies. However, optical disks will not abolish the need to preserve the original documents. Retrospective conversion to disk will be at least as difficult as present efforts to process library and archival backlogs and to perform retrospective cataloging. As Robert Patterson has noted, "We must be realistic in accepting the fact that large amounts of existing documentary information in printed or archival formats simply will <u>never</u> be made available electronically. We must continue to <u>manually</u> preserve the intellectual content, as well as the document bearing that information, when it warrants such efforts."[4] The technology of the optical disk project will not provide a panacea for deteriorating documentary collections.

<u>Mass Deacidification</u>

Acidity is the primary single cause of paper deterioration because it breaks down the polymer chains in cellulose and causes paper to become weak, brittle, and stained. It is primarily because of acid content (but also a function of environmental conditions and handling) that some 97% of book papers manufactured in the first forty years of this century will have a useful life of less than fifty years. Half of those are likely to last less than twenty-five years if they are used at all.[5] But even if every future paper document and book were printed on acid-neutral paper, libraries and archives would have a mammoth task in dealing with the acidic materials created in the past 130 years. The only way to offset the problems introduced by acid is to deacidify paper materials. Deacidification processes are designed to neutralize the acids in paper and to deposit an alkaline buffer or reserve that will inhibit the return to an acidic state. This procedure will substantially lengthen the useful life of paper materials--by as much as two- to sixfold, or up to 300 years-- but it does not reverse the effects of deterioration. The widely accepted Wei T'o products offer an effective way of deacidifying selected documents, but the process of washing individual leaves in the solution is quite time-consuming.

Given the dimensions of the acid-paper problem in most repositories and the labor and cost involved in currently available processes, it is clear that a less expensive deacidification procedure is needed. Many experiments in deacidification have sought to develop a process that is safe, affordable, and treats documents in large quantities. Two such procedures, in use at Princeton University and at the National Library/Public Archives of Canada, use the Wei T'o solution. The Library of Congress is testing a process using a diethyl zinc (DEZ) vapor. More recently, the Koppers Company announced a test project in mass deacidification, but the corporation subsequently suspended that project. Mass deacidification serves as another and different example of the ways in which emerging technologies provide new preservation strategies. A discussion of the Wei T'o and DEZ processes may help archivists assess their options.

At Princeton, individual papers or pages of books are sprayed with a solution of Wei T'o in a large-scale production operation. Because the spraying takes place in an open environment, there must be strict safety precautions such as the use of fume hoods and special apparel. This deacidification method is faster than the process of washing individual sheets, but it is still labor-intensive since it requires individual treatment of each leaf. Having deacidified two collections of about seventeen hundred volumes, Princeton conservator Robert Parliament has declared the procedure effective. He estimates that the process costs about twelve to fifteen dollars for treating each book--much less than the cost of deacidification methods that entail washing each leaf--and he hopes to realize lower unit costs as the staff gains more experience.[6]

A more high-tech approach, developed by Richard Smith (founder and president of Wei T'o Associates) for the Public Archives of Canada, has been in operation for three years; it treats materials in a pressure tank using a liquefied gas form of Wei T'o. Materials are loaded into baskets, placed in a pressure tank, and dried thoroughly so they will absorb as much solution as possible. Then gaseous Wei T'o is pumped into the tank and neutralizes the acids. As the liquid turns back into a gas, an alkaline reserve remains in the paper fibers. Materials are then held in a staging area until they return to proper moisture levels.

Candidates for this deacidification process must be chosen carefully; the wetting and drying processes can cause damage to documents with soluble inks, to leather and some imitation leather bindings, and to some plastic-covered and paperback books.[7] These effects can be reduced by careful screening and selection, but such procedures can be quite time-consuming and therefore expensive. On the other hand, several factors make the Wei T'o mass deacidification procedure attractive. It uses nontoxic chemicals in a closed system and seems to have no harmful side effects for humans or materials. The system treats some one hundred fifty books per day, but Smith estimates that it is capable of treating 120 thousand bound volumes per year if operated on a larger scale. Capital and operational expenses are reasonable; the present cost per volume is between three and four dollars, but this figure may be reduced by applying more efficient techniques. The Wei T'o process in use at the Public Archives of Canada, then, seems to have the capability of meeting the criteria of large-scale application, reasonable cost, and safety.

The Library of Congress Preservation Research and Testing Office is working with a vapor process of deacidification. The process uses diethyl zinc (DEZ) in a vacuum chamber to neutralize acids, and it leaves an alkaline reserve in the paper. After extensive testing, the DEZ test was deemed successful and, in September 1984, the Library of Congress was authorized to spend $11.5 million to construct a mass deacidification facility in Maryland. The facility, scheduled for completion in 1986, is expected to treat 500 thousand books per year at a cost of three to five dollars each when fully operational. The annual operating budget for the facility is estimated at about $3.5 million.

In the LC procedure, materials are loaded into a vacuum chamber and dried. Then the DEZ is pumped into the chamber and neutralizes the acid in the materials. When the DEZ is removed, moist carbon dioxide is introduced, producing a chemical reaction that leaves an alkaline reserve in the paper. The chamber is then cleared, and materials are taken to a staging area until they are adequately rehumidified.

Early problems with the DEZ process (such as inadequate penetration of bound materials and an iridescent residue on bindings) have been resolved, but there are still two major drawbacks to the process. First, DEZ demands special precautions because it is highly explosive upon contact with water and flammable in contact with air. Second, the procedure requires such a large capital investment that few organizations can ever hope to afford it. LC plans to use its facility first for routine treatment of incoming paper items, then for other collections in major need of deacidification. It is uncertain whether the facility will ever be available for general use, in view of the millions of volumes in the Library of Congress's own collections that require treatment.

Mass deacidification offers great potential for large-scale, affordable treatment of paper materials. As Carolyn Harris noted, "Deacidification is not, however, the panacea that the library profession was hoping it would be, for the process of deacidification is only a limited solution."[8] While mass deacidification will neutralize acid and can prevent further acid-caused deterioration, it cannot restore yellowed and brittle papers to their original condition. Mass deacidification must be integrated with other strategies to form an effective conservation/preservation program. Some individual institutions should eventually be able to afford systems such as those at Princeton and the Public Archives of Canada. However, it appears unlikely that a mass deacidification system for most institutions is imminent.

Developing a Plan of Action

This brief overview suggests the extent to which emerging technologies will affect archival preservation. Electronic communications and storage will call for some new procedures and reconsideration of some existing practices. On the other hand, developing technologies such as optical disk and mass deacidification may offer new and effective tactics for forestalling the deterioration of materials and preserving endangered information. Confronted with such complexities, some may be tempted either to give up in despair, because it is so hard to know where to begin, or to delay action until emerging technologies are available that will make the task simpler, quicker, and less expensive.

Archivists and librarians in the Southeast will have a new and valuable resource as they face the obstacles and opportunities associated with emerging technologies. SOLINET (Southeastern Library Network), a nonprofit membership organization that now provides advanced technology to over four hundred fifty libraries, has been awarded a grant by the National Endowment for the Humanities to establish a cooperative preservation program in the Southeast. This program provides a variety of services including education and training, field service, consultation, and disaster assistance. The SOLINET Preservation Program is helping repositories learn about and cope with the increasing number of challenges and options that arise with new technologies, and SOLINET will monitor new technologies that might be applicable to the needs of repositories in the Southeast.

Despite the uncertainty of the future, archivists can begin now to take steps to control and sometimes to reverse the deterioration of their collections. In an era of technological flux, present planning should be done in the context of emerging developments. As Pamela Darling has noted, "There are many complex technical and procedural problems involved in preservation work, for many of which there is not yet a consensus about the best solution. There are few absolutes, and what [appear now] to be well-founded may seem naive, even wrong, in the light of subsequent developments."[9] It is, therefore, essential to exercise caution and judgment in the implementation of preservation efforts. Some specific tactics have been suggested above. General guidelines discussed below may be useful as archivists begin to develop a plan of action for preservation.

Every archivist and librarian should have an awareness of preservation issues, including the causes of deterioration and basic strategies for controlling it. The basic issues in preservation are well elucidated in many books and manuals that offer "introductory courses" and preservation-oriented journals can help archivists stay informed of current developments.[10] The well-informed archivist can, in turn, begin to increase administrators' understanding of preservation needs. This effort can strengthen future requests for funding of preservation activities and personnel.

Archivists can begin "doing preservation" as information and resources are available. While it will probably be impossible to adhere immediately or fully to preservation guidelines for environmental control and internal procedures, even apparently minor steps (such as reductions of temperature and light levels or improvement of housekeeping and shelving practices) will help extend the life of materials. This kind of basic action, phased in as the archivist's training and the repository's resources permit, will provide a solid foundation upon which more sophisticated approaches can be built.

In dealing with emerging technologies, some decisions will have to be made on partially speculative considerations, but proven archival principles should be applied as far as possible. Thus, even though there are unanswered questions about the preservation of floppy disks, one should store them in acid-free enclosures, for the fact that acid erodes the plastic base of computer tapes and disks is well established. The archivist who speculates that some present technologies will someday be obsolete will apply strategies to ensure that information is not lost when the medium is. For example, given the unpredictability of future microcomputer developments, archivally valuable data from microcomputers can be preserved in printed copies. In this era of rapid technological change, archivists and librarians should make sure they are not "trapped" in an outmoded technology. Research, development, testing, and implementation of new technologies will take time and will change current practices. In the interim, it is best for preservation planners to act on those principles that are proven, while positioning themselves to cope with the potential impact of emerging technologies. As new technologies become available, they should be assessed on the basis of their consistency with established archival and preservation principles and the amount of testing and evaluation they have received.

Preservation programs, like those in automation, will benefit from a "networking" approach in which repositories pool their resources to realize financial savings and/or improved service. Preservation programs such as those of the Midwest Cooperative Conservation Program, the Northeast Document Conservation Center, SOLINET, and the Society of American Archivists already provide training and consultative services to augment local preservation efforts. These could eventually make new technologies widely available to archives and libraries if there is adequate commitment from their constituencies. Most observers of the preservation field anticipate that cooperative programs and facilities will proliferate as archives and libraries seek efficient ways of applying or responding to new technologies.

Emerging technologies will offer new sets of problems and solutions. But archivists and librarians can prepare for these effects by educating themselves and other staff members, by establishing sound preservation practices, by anticipating long-range trends, and by fostering cooperative approaches to common needs. While the task of preserving the vast resources in repositories may seem overwhelmingly immense, careful planning can make preservation in the information age a challenging opportunity rather than an insurmountable problem.

NOTES

[1] Carolyn Clark Morrow, The Preservation Challenge: A Guide to Conserving Library Materials (White Plains, NY: Knowledge Industry Publications, 1983), 58-59.

[2] These guidelines, and additional references, are available in RLG Preservation Manual (Stanford, CA: Research Libraries Group, 1983), 120-121.

[3] A 7.0 pH value is "neutral"; values lower than 7.0 are acidic, and those above 7.0 are alkaline. Because the pH values are calculated on a logarithmic scale, each decrease of 1.0 represents a tenfold change in acidity; thus, 6.0 is ten times more acidic than 7.0, and 5.0 is 100 times more acidic than the neutral 7.0. For a more detailed and technical account of the action of acids in paper, see William K. Hollinger, Jr., "The Chemical Structure and Acid Deterioration of Paper," Library

Hi Tech 1 (Spring 1984): 51-57, and Mary Lynn Ritzenthaler, Archives and Manuscripts: Conservation (Chicago: Society of American Archivists, 1983), 15-20, 78-79.

[4] "Editorial," Conservation Administration News, no. 20, (January 1985), 3.

[5] Results of a study by William J. Barrow; cited in Pamela W. Darling, Preservation Planning Program: Assisted Self-Study Manual (Washington, DC: Association of Research Libraries, Office of Management Studies, 1982), 2. Some efforts are being made to encourage publishers to use more permanent/durable papers, and an ANSI standard Z39.48-1984, "Permanence of Paper for Printed Library Materials," has recently been published. Guidelines for producing durable and long-lasting paper and bindings have been developed by a Committee on Production Guidelines for Book Longevity, supported by the Council on Library Resources and the Andrew W. Mellon Foundation. The report is contained in a pamphlet, Book Longevity (Washington, DC: Council on Library Resources, 1982), and has been widely distributed to publishers in an effort to raise the industry's awareness of preservation issues.

[6] Ann Swartzell, "Deacidification," RTSD Newsletter 9 (1984): 72.

[7] Ibid.

[8] Carolyn Harris, "Mass Deacidification: Science to the Rescue?", Library Journal 104 (July 1979): 1423.

[9] Pamela W. Darling, Preservation Planning Program: Resource Notebook (Washington, DC: ARL/OMS, 1982), i.

[10] It would be useful to begin by reading Carolyn Clark Morrow's The Preservation Challenge

and Mary Lynn Ritzenthaler's Archives and Manuscripts: Conservation. Further readings are suggested in the bibliographies of these two works, as well as in George and Dorothy Cunha's Library and Archives Conservation: 1980s and Beyond (Metuchen, NJ: Scarecrow Press, 1983), and in Pamela W. Darling's Preservation Planning Program: Resource Notebook. The Abbey Newsletter and Conservation Administration News are excellent and inexpensive periodical sources for current awareness in preservation.